

***Claims:***

1. A device for interacting with a fluid moving relative to said device, said device comprising:

- 5        - a body characterized by an axis of rotation and having a periphery, said body being rotatable about said axis of rotation;
- 10      - a plurality of vanes associated with said body, each one of said plurality of vanes being movable between an extended position relative to said periphery and a retracted position relative to said periphery; and
- 15      - a control mechanism coupled to said plurality of vanes for selectively moving each one of said plurality of vanes between said extended position and said retracted position during rotation of said body.

2. A device as defined in claim 1, wherein said control mechanism is operative to selectively move each one of said plurality of vanes such that a first vane of said plurality of vanes moves from said extended position into said retracted position and a second vane of said plurality of vanes concurrently moves from said retracted position into said extended position.

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3. A device as defined in claim 1, wherein said control mechanism is operative to selectively move each one of said plurality of vanes such that a first vane of said plurality of vanes moves into a first position that is one of said extended position, said retracted position, and a position intermediate said extended position and said retracted position, and a second vane of said plurality of vanes concurrently moves into a second position different from said first position.
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4. A device as defined in claim 1, wherein said control mechanism is operative to selectively move each one of said plurality of vanes such that each particular vane  
5 is in said extended position when a tangential velocity of said particular vane is substantially perpendicular to a freestream direction of movement of the fluid relative to said device, and is in said retracted position when the tangential velocity of said  
10 particular vane is substantially parallel to the freestream direction of movement of the fluid relative to said device.
- 15 5. A device as defined in claim 1, wherein said control mechanism is operative to selectively move each one of said plurality of vanes such that each particular vane is in said extended position when a tangential velocity of said particular vane is at a first angle to a freestream direction of movement of the fluid relative to said device, and is in said retracted position when  
20 the tangential velocity of said particular vane is at a second angle to the freestream direction of movement of the fluid relative to said device, said first angle being in the range of about 85° to about 95° and said  
25 second angle being in the range of about -5° to about 5°.
- 30 6. A device as defined in claim 1, wherein said control mechanism is operative to selectively move each one of said plurality of vanes such that each particular vane is in said extended position when a tangential velocity of said particular vane is at a first angle to a freestream direction of movement of the fluid relative to said device, and is in said retracted position when

the tangential velocity of said particular vane is at a second angle to the freestream direction of movement of the fluid relative to said device, said first angle being in the range of about 75° to about 105° and said 5 second angle being in the range of about -15° to about 15°.

7. A device as defined in claim 1, wherein said control mechanism is operative to selectively move each one of 10 said plurality of vanes such that each particular vane is in said retracted position when a tangential velocity of said particular vane is directed against a freestream direction of movement of the fluid relative to said device.

15 8. A device as defined in claim 1, wherein each one of said plurality of vanes is movable between said extended position and said retracted position via a slot provided in said periphery of said body.

20 9. A device as defined in claim 1, wherein each one of said plurality of vanes includes a plurality of telescoping elements such that each particular vane is telescopically movable between said extended position 25 and said retracted position.

10. A device as defined in claim 1, wherein each one of said plurality of vanes is capable of winding and unwinding such that each particular vane is movable 30 between said extended position and said retracted position by unwinding and winding said particular vane.

11. A device as defined in claim 1, wherein said control mechanism includes a mechanical linkage interacting

with said plurality of vanes for selectively moving each one of said plurality of vanes between said extended position and said retracted position during rotation of said body.

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12. A device as defined in claim 1, wherein said control mechanism includes:

- a plurality of actuators, each one of said plurality of actuators being connected to a respective vane of said plurality of vanes and being adapted to move said respective vane between said extended position and said retracted position; and
- a controller coupled to said plurality of actuators, said controller being adapted to selectively activate or deactivate each one of said plurality of actuators.

13. A device as defined in claim 1, further comprising a transmission mechanism associated with said body for transmitting energy associated with rotation of said body to a remote device.

14. A device as defined in claim 13, wherein said transmission mechanism includes a shaft connected to said body and to said remote device.

15. A device as defined in claim 1, wherein the fluid is air.

30 16. The device of claim 1 adapted for use in a stationary energy generator.

17. A vehicle including a device for interacting with a fluid moving relative to said device, said device

comprising:

- a body characterized by an axis of rotation and having a periphery, said body being rotatable about said axis of rotation;
  - 5 - a plurality of vanes associated with said body, each one of said plurality of vanes being movable between an extended position relative to said periphery and a retracted position relative to said periphery; and
  - a control mechanism coupled to said plurality of vanes for selectively moving each one of said plurality of vanes between said extended position and said retracted position during rotation of said body.
- :15 18. A vehicle as defined in claim 17, wherein said control mechanism is operative to selectively move each one of said plurality of vanes such that a first vane of said plurality of vanes moves from said extended position into said retracted position and a second vane of said plurality of vanes concurrently moves from said retracted position into said extended position.
- 20 19. A vehicle as defined in claim 17, wherein said control mechanism is operative to selectively move each one of said plurality of vanes such that a first vane of said plurality of vanes moves into a first position that is one of said extended position, said retracted position, and a position intermediate said extended position and said retracted position, and a second vane of said plurality of vanes concurrently moves into a second position different from said first position.
- 25 30 20. A vehicle as defined in claim 17, wherein said control mechanism is operative to selectively move each one of

said plurality of vanes such that each particular vane is in said extended position when a tangential velocity of said particular vane is substantially perpendicular to a freestream direction of movement of the fluid relative to said device, and is in said retracted position when the tangential velocity of said particular vane is substantially parallel to the freestream direction of movement of the fluid relative to said device.

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21. A vehicle as defined in claim 17, wherein said control mechanism is operative to selectively move each one of said plurality of vanes such that each particular vane is in said extended position when a tangential velocity of said particular vane is at a first angle to a freestream direction of movement of the fluid relative to said device, and is in said retracted position when the tangential velocity of said particular vane is at a second angle to the freestream direction of movement of the fluid relative to said device, said first angle being in the range of about 85° to about 95° and said second angle being in the range of about -5° to about 5°.

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22. A vehicle as defined in claim 17, wherein said control mechanism is operative to selectively move each one of said plurality of vanes such that each particular vane is in said extended position when a tangential velocity of said particular vane is at a first angle to a freestream direction of movement of the fluid relative to said device, and is in said retracted position when the tangential velocity of said particular vane is at a second angle to the freestream direction of movement of the fluid relative to said device, said first angle

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being in the range of about 75° to about 105° and said second angle being in the range of about -15° to about 15°.

- 5 23. A vehicle as defined in claim 17, wherein said control mechanism is operative to selectively move each one of said plurality of vanes such that each particular vane is in said retracted position when a tangential velocity of said particular vane is directed against a  
10 freestream direction of movement of the fluid relative to said device.
- 15 24. A vehicle as defined in claim 17, wherein each one of said plurality of vanes is movable between said extended position and said retracted position via a slot provided in said periphery of said body.
- 20 25. A vehicle as defined in claim 17, wherein each one of said plurality of vanes includes a plurality of telescoping elements such that each particular vane is telescopically movable between said extended position and said retracted position.
- 25 26. A vehicle as defined in claim 17, wherein each one of said plurality of vanes is capable of winding and unwinding such that each particular vane is movable between said extended position and said retracted position by unwinding and winding said particular vane.
- 30 27. A vehicle as defined in claim 17, wherein said control mechanism includes a mechanical linkage interacting with said plurality of vanes for selectively moving each one of said plurality of vanes between said extended position and said retracted position during

rotation of said body.

28. A vehicle as defined in claim 17, wherein said control mechanism includes:

- 5        - a plurality of actuators, each one of said plurality of actuators being connected to a respective vane of said plurality of vanes and being adapted to move said respective vane between said extended position and said retracted position; and
- 10      - a controller coupled to said plurality of actuators, said controller being adapted to selectively activate or deactivate each one of said plurality of actuators.

- 15 29. A vehicle as defined in claim 17, said device further comprising a transmission mechanism associated with said body for transmitting energy associated with rotation of said body to a remote device in said vehicle.

- 20 30. A vehicle as defined in claim 29, wherein said transmission mechanism includes a shaft connected to said body and to said remote device.

- 25 31. A vehicle as defined in claim 29, wherein said remote device is operative to convert the energy associated with rotation of said body into mechanical or electrical energy.

- 30 32. A vehicle as defined in claim 31, wherein said remote device is one of a motor, a battery charger, and an electricity generator.

33. A vehicle as defined in claim 17, further comprising a

control unit interconnecting said device and an accelerator system of said vehicle.

34. A vehicle as defined in claim 33, wherein, when said vehicle is accelerating or cruising, said control unit controls said device such that said control mechanism selectively moves each one of said plurality of vanes between said extended position and said retracted position during rotation of said body without increasing a total frontal area of said vehicle.  
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35. A vehicle as defined in claim 33, wherein, when said vehicle is accelerating or cruising, said control unit controls said device such that said control mechanism selectively moves each one of said plurality of vanes between said extended position and said retracted position such as to generate less drag on said vehicle than if said device was omitted from said vehicle.  
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36. A vehicle as defined in claim 17, further comprising a control unit interconnecting said device and a braking system of said vehicle.  
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37. A vehicle as defined in claim 36, wherein, when said vehicle is braking, said control unit controls said device such that said body is prevented from rotating about said axis of rotation and said control mechanism selectively moves each one of said plurality of vanes between said extended position and said retracted position so as to generate a larger drag on said vehicle than when said vehicle is not braking.  
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38. A vehicle as defined in claim 36, wherein, when said vehicle is braking, said control unit controls said  
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device such that said body is rotated about said axis of rotation in a certain direction so as to generate a downward lift force on said vehicle and said control mechanism selectively moves each one of said plurality of vanes between said extended position and said retracted position so as to generate a larger drag on said vehicle than when said vehicle is not braking.

- 5           39. A vehicle as defined in claim 17, wherein said vehicle  
10          is a ground vehicle.
40. A vehicle as defined in claim 17, wherein said vehicle  
is a watercraft.
- 15   41. A vehicle as defined in claim 17, wherein said vehicle  
is an aircraft.